

Preface to the Second Edition

Many interesting and exciting developments have occurred since the publication of the first edition in 1990 that make it appropriate to revise portions of the book, and to present additional material of interest to amateurs and electrical engineers alike.

It's been five years since the ARRL sold out all 10,000 copies of the first edition, during which time I've been besieged with queries asking why no copies have been available since 1995. The reason is that in 1991 a controversy arose concerning the use of conjugate matching with respect to RF power amplifier operation. In the opinion of the current ARRL Technical Department, a conjugate match between an RF power amplifier and its load is not possible. Consequently, since *Reflections* is fundamentally based on the principle of conjugate matching, the technical editors at the League believe portions of the book are inaccurate, and therefore discontinued its publication in 1995. In addition, my writings on conjugate matching that appeared in the *ARRL Handbooks* from 1986 to 1994 have been deleted. The resolution of the controversy concerning conjugate matching is discussed in depth in Chapter 19.

One important addition is an illuminating discussion with a basic, but unusual, approach that brings new insight to understanding the concept of impedance and impedance matching. The discussion was written specifically for this book by Professor John C. Fakan, Ph.D., E.E., KB8MU, which appears in Appendix 11.

The original Chapter 19, "The Conjugate Match and The Z_0 Match" has been revised and expanded to provide greater insight, now appearing as Chapter 24. The original material also appeared in all editions of the *ARRL Handbook* from 1986 to 1994, but was deleted in 1995, and all subsequent editions, for reasons that will become evident as you continue reading.

Appendix 7 has been added to explain how to determine the amount of increase in forward power traveling on a transmission line that results when a conjugate match is performed with the matching network located at the input of the line, and with the line terminated in a mismatched load. Appendix 7A provides a hand calculator program for calculating the amount of the increase.

Appendix 8 has been added to explain how to determine the amount of power lost to dissipation in the transmission line due to reflections on

the line, based on the value of the SWR, the attenuation of the line when matched, and the length of the line. Appendix 8A provides a hand calculator program for calculating the amount of power lost to SWR.

Appendix 9 has been added to present a comprehensive view of the definition of the Conjugate Matching Theorem. Four Axioms of the Theorem are stated, along with pertinent statements by Dr. William L. Everitt, H. Wayne Beaty, and Robert W. Beatty, senior member of the IEEE, who discuss practical applications of the Theorem, including use in RF power amplifiers.

Appendix 10 has been added to include the IEEE definitions of impedance, and of dissipative and non-dissipative resistance. Discussion also includes an explanation of the prevalently misunderstood subject of *non*-dissipative resistance.

Appendix 12 has been added to present test procedures and measurements in addition to those appearing in Sec 19.8, used in measuring the output impedance of RF amplifiers, which provides additional proof that a conjugate match does indeed occur when matching the RF power amplifier to its load

A new Chapter 19, "On the Nature of the Source of Power in Class B and C Amplifiers," was written to resolve the longstanding controversy concerning the conjugate match in RF transmission systems when the source of power is an RF power amplifier. Measurements which prove the existence of the conjugate match when the power source is an RF power amplifier are presented. The controversy originated with the appearance of an article in *QST* published in November 1991, which stated that no conjugate match in the system is possible when the source is an RF power amplifier. This is the position the ARRL has held steadfastly since the *QST* article was published, which reversed the position of their previous technical editors. Their new position resulted in the deletion of my material on conjugate matching that appeared in all issues of the *ARRL Handbook* from 1986 through 1994, and discontinuing publication of the first edition of this book. From reading the new Chapter 19 you will be able to understand why the present ARRL position on Conjugate Matching is incorrect.

Several professional RF engineers have reviewed the material appearing in Chapter 19, and found it to be a factual representation of RF power amplifier operation with respect to conjugate matching to its load. In their expert opinion, the facts as stated in Chapter 19 resolve the controversy, and thus signal its conclusion. Three of these engineers are retired from the RF transmitter design group of the Collins Radio Corp., (colleagues of the author of the *QST* article mentioned above). They are Jan Hornbeck, NØCS; Warren Amfahr, E.E., WØWL; and a third who wishes to remain anonymous. Others include Robert P. Haviland, E.E., W4MB, retired RF engineer from GE; John C. Fakan, Ph.D., EE, KB8MU, consultant, formerly consultant to NASA; Forrest E. Gehrke, BSEE, K2BT, retired microwave engineer of the former RCA; and Al Helfrick, Ph.D. in

Applied Science, K2BLA, Professor of Avionics, Embry-Riddle Aeronautical University.

In addition, I also wish to acknowledge outstanding assistance from the following people in the preparation of this book, without whom this new edition would not have been possible. They are John S. (Jack) Belrose, Ph.D. (Cantab), VE2CV, and Forrest Gehrke, K2BT. A special appreciation is due Professor John C. Fakan, KB8MU, for his extraordinary assistance in furthering the understanding of impedance and impedance matching, and the appreciation that the output voltage/current characteristics of the tank circuit of the RF power amplifier are linear.

And finally, I wish to thank my wife, Jean B. Mayhew-Maxwell, Emeritus Professor of Speech at Central Michigan University (my alma mater), for her unswerving support while alternating between being my style editor, proof reader, and computer widow during the long periods I spent at the keyboard writing this edition. I also thank Armond Noble, N6WR, Publisher of *Worldradio*, for publishing my book, and Clayton Guy, K6GUY, 17, who performed the Herculean task of the complex page formatting of the book. After two printings of 5,000 copies each of the 1st edition of *Reflections*, published by the *ARRL*, all copies were sold out in 1995, and the League's decision was to print no additional copies. However, between 1995 and 1999 I received literally hundreds of letters worldwide, asking where a copy could be obtained. I mentioned to Armond that, because of the obvious continuing demand for the book, I would like to publish a 2nd edition. His immediate response was that he'd be pleased to publish it. So my thanks go to Armond for rescuing this project dear to my heart.

I hope you will enjoy reading this new edition, and benefit from the additional material.

Walter Maxwell, W2DU
DeLand, Florida
February 2001